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Alberta

ENERGY AND
NATURAL RESOURCES
Resource Evaluation
and Planning

SOIL SURVEY AND AGRICULTURAL RATING
OF
THE SUNLAND DRAINAGE PROJECT AREA

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OF

THE SUNLAND DRAINAGE

PROJECT AREA

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TABLE OF CONTENTS

	Page
1. INTRODUCTION	1
2. DESCRIPTION OF STUDY AREA	2
2.1 Location and Size	2
2.2 Physiography	2
2.3 Land Use	2
3. METHODOLOGY	4
3.1 Soil Survey	4
3.2 Data Analyses and Interpretation	5
4. THE SOILS OF THE PROJECT AREA	6
4.1 General Soil Patterns	6
4.2 Soil Units	6
5. SOIL CAPABILITY CLASSIFICATION FOR AGRICULTURE	8
5.1 Introduction	8
5.2 Soil Properties and Their Implication for Capability.	8
5.3 Capability Ratings	10
6. REFERENCES	13
GLOSSARY	14
APPENDIX 1 - Profile Descriptions of the Soil Units	15
APPENDIX 2 - Summary of Soil Analysis	25

LIST OF TABLES

Table		Page
1	Key to Major Characteristics of the Soil Units	7
2	Capability Rating of the Soil Units	9

LIST OF FIGURES

Figure		
1	Location Map	3

1. INTRODUCTION

A detailed soil survey of the Sunland Drainage project area was initiated in the summer of 1984 at the request of Alberta Environment, Water Resources Administration Division, with the objective of characterizing the area in terms of soils and landforms.

The project area has been subject to complaints from landowners concerning flooded agricultural lands and poor drainage conditions. During periods of highwater, some of the agricultural lands are flooded and certain road grades and farm crossings in the area are invariably damaged.

The Department of Environment is presently considering a cost-sharing drainage project with the County of Lamont, the purpose being one of providing a drainage system for the reclamation of the area. To evaluate the value and cost-effectiveness of the drainage project, the Department is interested in identifying the agricultural capability of the area after reclamation.

The main objective of this study is to provide, according to the Canadian Soil Classification System, a detailed soil survey, and a soil capability rating for agriculture based on assessment of soil conditions of the project area.

2. DESCRIPTION OF STUDY AREA

2.1 Location and Size

The study area is located between the towns of Sunland and Whitford approximately 100 km east of Edmonton (Figure 1). It covers about 940 acres and includes parts of Section 6, Township 47, Range 15, and Sections 12, 13, 14, 23, Township 57, Range 16, west of the fourth meridian.

2.2 Physiography

The area lies within the Whitford Plain District, which is a subdivision of the Tawatinaw Plain Section of the Eastern Alberta Plains Region (Pettapiece, 1982).

The bedrock in the general area is composed of bentonitic sandstones, carbonaceous shales with coal seams, ironstone nodules and gypsum crystals of the Pale Bed's Formation of the Upper Cretaceous age (Bowser, et. al., 1962).

The land surface is characterized by depressional to gently undulating topography with slopes ranging from zero to five percent.

The principal surficial deposits found in the area are till and lacustrine materials.

2.3 Land Use

The majority of the project area is presently used for grazing and hay production. Grain production is limited to those areas that have better drainage and topographic conditions.

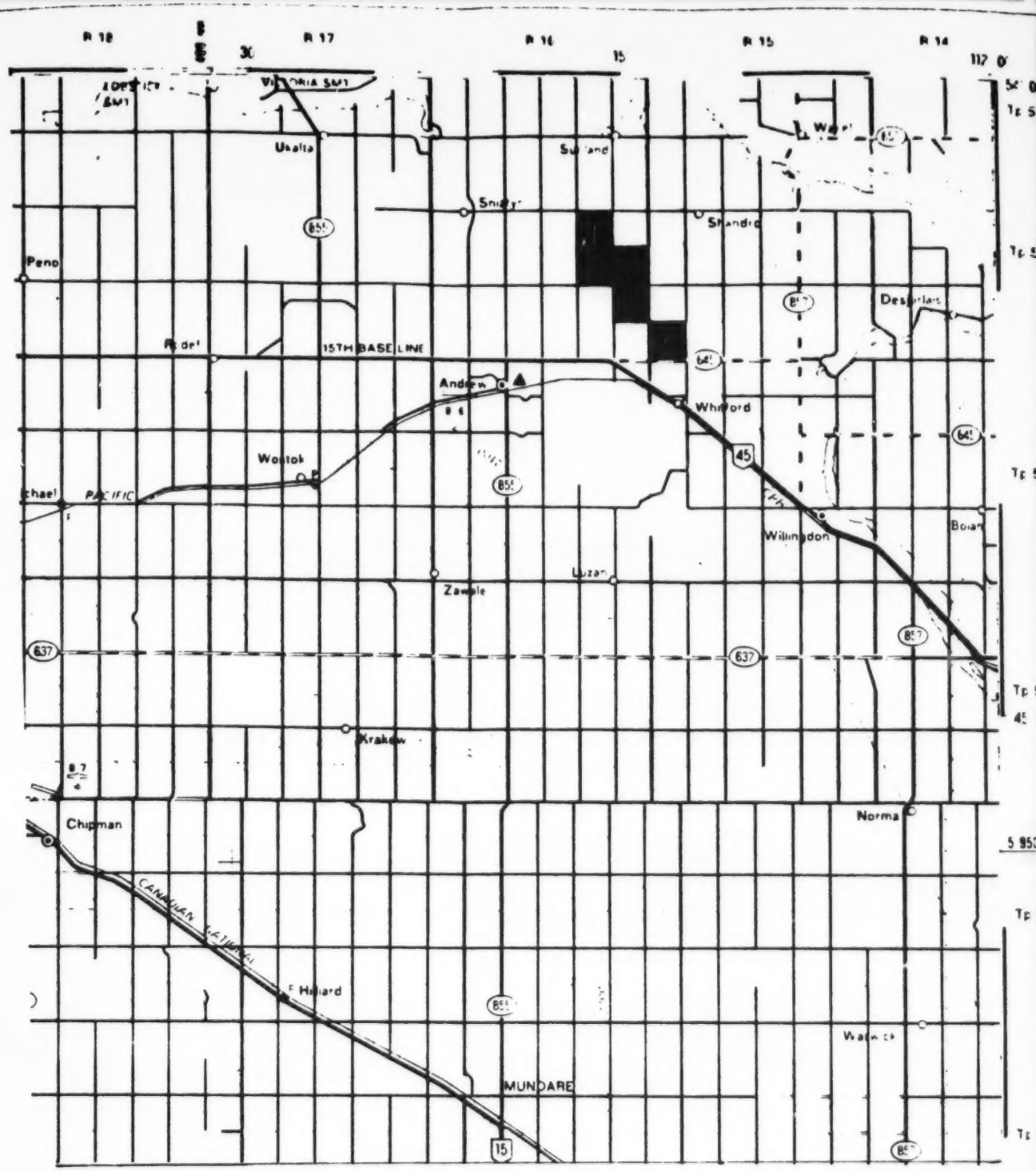

Figure 1. Location Map

Study Area

3. METHODOLOGY

3.1 Soil Survey

Initially, the detailed subdivision of the study area was done by analyzing aerial photography at a scale of 1:10 000. The delineated soil units, areas of land on particular parent materials having fairly homogeneous soils, topography and drainage, were verified and supplemented with fieldwork conducted during the month of August, 1984.

The soils in the area were classified according to the Canadian System of Soil Classification (1978). The soil units established were based mainly on the kinds and degrees of development of soil horizons, on lithologic differences in soil parent materials, and on the content of carbonates and other salts. Other soil properties measurable in the field, such as soil texture, color and thickness of horizons, soil structure and consistency, were recorded.

Soil profiles were examined at a total of 29 sites by excavating the site with a shovel. These observation sites are indicated on the soil map. Representative samples of various soils in the area were collected for chemical analyses; a total of 42 samples from 17 sites were analyzed by Norwest Soil Research Ltd., using standard methods (McKeague, 1978).

All of the soil samples were analyzed for pH, salinity and saturation percentage. Further analyses for soluble ions and sodicity

were conducted on those soils indicating high pH and high salinity. a summary of the analyses is presented in Appendix 2.

3.2 Data Analyses and Interpretation

The observable chartacteristics of the soils and the results of chemical laboratory analyses were used to predict the soils performances under agriculture. The soil capability classification for agriculture given in this report is an interpretive grouping based mainly on texture, drainage, topographic position and the degree of salinity in the soil. The rating indicates the agricultural potential of the soils according to any hazards that would remain after reclamation and that would therefore be a continuing limitation to agricultural production (See Soil Survey and Soil Rating maps - enclosed).

4. THE SOILS OF THE PROJECT AREA

4.1 General Soil Patterns

The study area consists mainly of poorly drained Gleysolic soils and moderately well drained Black Chernozems. All soils have dark colored Ah horizons, 15-30 cm thick, indicating high organic matter content and available nutrients for plant use.

Rego Humic Gleysols and carbonated Rego Humic Gleysols are the dominant soils in level to depressional areas adjacent to the natural drainage channel. The Orthic Black Chernozems are well to moderately well drained and are confined to the undulating areas.

4.2 Soil Units

Ten soil units on the basis of soil type, parent material and the degree of salinity were recognized. Table 1 summarizes the soil units in terms of their surface and subsurface textures, slope and drainage classes, parent material, and the acreages within the project area.

A detailed soil profile description of each soil unit is given in Appendix 1.

Table 1

KEY TO MAJOR CHARACTERISTICS OF THE SOIL UNITS

Soil Unit	Acreage	Site (Soil)	Soil Type	Surface Texture	Subsoil Texture	Slope Class	Drainage Class	Parent Material
K1	44	1, 11	Rego Humic Gleysol (slightly saline)	SiL	SiCL-C	1	P	Silt loam to silty clay loam lacustrine veneer, 40 to 60 cm thick, over clay loam moraine (till)
K2	34	13, 16, 21	Carbonated Rego Humic Gleysol (slightly saline)	SiCL	SiCL-C	1-2	P	
K3	8	9	Gleyed Rego Black	L-SCL	CL	2	Imp	
L1	88	14, 19, 23, 28, 29	Rego Humic Gleysol and carbonated Rego Humic Gleysol (slightly saline)	SiL-SiCL	SiCL-SiC	1-2	P	Silty clay loam to silty clay lacustrine deposit. In some profiles texture of the material is sand, loamy sand or sandy loam at a depth of 70-100 cm from the surface
L2	88	7, 15, 17, 26, 27	Rego Humic Gleysol (moderately saline, moderately sodic)	SiL	SiCL-SiC	1	P	
L3	60	12, 22 25	Rego Humic Gleysol and carbonated Rego Humic Gleysol (strongly saline, strongly sodic)	SiCL-SiC	SiCL-SiC	1	P	
M1	82	2, 3	Rego Humic Gleysol and carbonated Rego Humic Gleysol (slightly saline)	L-CL	CL-C	1-2	P	Clay loam to clay morainal material (till). There are only a few small stones in the soil profiles.
M2	51	4, 5, 18, 20	Rego Humic Gleysol and carbonated Rego Humic Gleysol (moderately saline, moderately sodic)	L-SiL	CL-C	1-2	P	
M3	63	6, 10,	Rego Humic Gleysol and carbonated Rego Humic Gleysol (strongly saline, strongly sodic)	CL-SiC	CL-C	1-2	P	
M4	419	8	Orthic Black	SL-L	CL-C	3	MW	

Soil Textures

SL - sandy loam
L - loam
SiL - silt loam
SiCL- silty clay loam
SiC - silty clay
SCL - sandy clay loam
CL - clay loam
C - clay

Slope Classes

1 - 0-0.5% slopes
2 - 0.5-2% slopes
3 - 2.5-5% slopes

Soil Drainage

MW - moderately well drained
Imp - imperfectly drained
P - poorly drained

5. SOIL CAPABILITY CLASSIFICATION FOR AGRICULTURE

5.1 Introduction

The soil capability rating indicates the general suitability of the project area for agriculture in its post-drainage state. The rating is based on interpretation of soil physical and chemical properties that identify the continuing limitations of the soils after reclamation.

The criteria used to evaluate the kind and degree of limitations are largely adopted from the publication "Soil Quality Criteria for Agriculture" by Agriculture Canada. However, the guidelines outlined in this document are for well drained soils, and may not provide an adequate framework for rating of soils in reclaimed areas. The soil capability ratings of the Sunland Drainage Project area (Table 2) are inferred qualities of soils based on laboratory data and field observations.

5.2 Soil Properties and Their Implication for Capability

The soil properties that are considered to be important in assessing soil capability in the area are: wetness, texture, salinity and sodicity.

Soil wetness refers to the rapidity and extent of the removal of water from the soil, in relation to additions, especially by surface runoff and by flow through the soil to underground spaces. Wetness in the nearly level or depressional areas within the project area is

Table 2

CAPABILITY RATING OF THE SOIL UNITS

Soil Unit	Acreage	Expected Wetness	Texture		Salinity	Sodicity	Degree of Limitation to Agricultural Use After Drainage
			Surface	Subsoil			
M4	419	None	L	CL-C	Low	Low	None
K1, K2, K3, L1, M1	256	Sheetwash	SiL-SiCL	SiCL-C	Low	Low	Slight to moderate
L2, M2	139	Ponding, slow permeability	L-SiL	SiCL-SiC	Moderate	Moderate	Moderate
L3, M3	123	Ponding, slow permeability	SiL-SiC	CL-SiC	High	High	Severe

evident during highwater periods which might become a continuing limitation to agricultural use after reclamation.

Soil texture indicates the relative proportions of clay, silt and sand below two millimetres in diameter. The textures of the soils of the project area are generally moderately fine to fine which may cause slow permeability and consequent puddling, poor tilth and slow drying.

Because of their topographic position and the nature of the parent material, some of the soils in the area have salt concentrations of sufficient magnitude to affect crop growth or limit the range of crops that might be grown. Soils with moderate accumulation of salts, of 4 to 8 mS/cm, and high concentration of salts, of more than 8 mS/cm, have unfavorable properties for the growth of most crops.

Soils with high levels of exchangeable sodium (SAR [sodium absorption ratio] greater than 12) are called sodic soils. These soils are likely to become sticky when wet and hard when dry because of dispersion of sodium rich clays. Permeability and water movement within these soils is greatly reduced.

5.3 Capability Ratings

The capability ratings of soils of the project area reflect their potential for agricultural use. They also identify the continuing limitations of these soils for agriculture after reclamation.

The soils of the study area have been grouped into soil units and capability classes as described in Table 2. Their location and extent are shown on the soil rating map accompanying this report.

The M4 soil unit have no limitations for agricultural use. The soils are Orthic Black Chernozems confined to undulating areas with convex or sloping surfaces. These soils are presently under cultivation and appear to be productive. Some of the soils adjacent to the drainage channel might be subject to periodic flooding and wetness. With improved drainage conditions, all of the soils within the M4 soil unit are expected to perform favorably under cultivation.

The soil units K1, K2, K3, L1 and L2 represent Rego Humic Gleysols and carbonated Humic Gleysols developed on variable parent materials. These soils are poorly drained and slightly saline/sodic which limits their use somewhat for agriculture. Due to their topographic positions, many of these soils would still be subject to some wetness after drainage. Because of their impeded drainage the soils are rated as being suitable for the production of forage crops. However, under continuous forage crops, the drainage and the tilth of these soils are expected to improve to such an extent that they can be used for arable culture.

The L2 and M2 soil units include poorly drained Rego Humic Gleysols and carbonated Rego Humic Gleysols located on level to depressional landscapes. The soils are moderately saline/sodic and have slow permeability which restricts the rate of water movement through the soil. With improved drainage conditions, these soils are

expected to be suitable for pasture and hay production.

Strongly saline/sodic soils of the project area are represented by the L3 and M3 soil units. These soils are poorly drained and occupy level to depressional areas. Because of their high sodicity, the soils will likely remain poorly structured, and impermeable to the movement of water. Even with a drainage system, the soils will still be subject to excessive wetness making them unsuitable for crop production.

6. REFERENCES

Alberta Soils Advisory Committee, not dated. Soil Quality Criteria for Agriculture. Agriculture Canada.

Bowser, W.E., A.A. Kjearsgaard, T.W. Peters and R.E. Wells. 1962. Soil Survey of Edmonton Sheet (83-H). Report No. 21, Alberta Soil Survey, Edmonton.

Pedocan Land Evaluation Ltd., 1983. Soil, Vegetation and Aquatic Mapping: Whitford Lake, Rush Lake and Svit Drain. Consultant's report to Planning Division, Alberta Environment.

APPENDIX 1

Profile Descriptions of the Soil Units

Soil Unit K1

Soil Type : Rego Humic Gleysol

Parent Material : Lacustrine veneer over moraine

Slope : 0-1%

Drainage Class : Poor

Soil Profile Description

Ah 1 0-20 cm; black (10YR 2/1); silt loam; amorphous; friable, non-sticky, slightly plastic, soft; gradual, smooth boundary

Ah 2 20-29 cm; very dark brown (10YR 2/2); loam; amorphous; friable, slightly sticky, slightly plastic, soft; clear, smooth boundary

Cg 29-47 cm; light brownish gray (2.5Y 6/2); loamy sand; many, fine, prominent reddish brown and gray mottles; single grain; loose, non-sticky, non-plastic; gradual, wavy boundary

II Cg 47-100+ cm; light yellowish brown (2.5Y 6/4); silty clay loam; fine, prominent reddish brown and gray mottles; amorphous; friable, sticky and plastic, hard

Comments

- the soil is slightly saline

Soil Unit K2

Soil Type : Rego Humic Gleysol, carbonated

Parent Material : Lacustrine veneer over moraine

Slope : 0-3%

Drainage Class : Poor

Soil Profile Description

Ahk 0-20 cm; black (10YR 2/1); silty clay loam; weak, fine granular; amorphous; friable, slightly sticky, slightly platic, slightly hard; clear, smooth boundary

Cgk 20-60 cm; light olive brown (2.5Y 5/4); silty clay; many, prominent, reddish brown and gray mottles; amorphous; firm, sticky and plastic, very hard; gradual, smooth boundary

II Cg 60-90+ cm; light brownish gray (2.5Y 6/2) clay; many, prominent, reddish brown and gray mottles; amorphous; firm, sticky and plastic, very hard

Comments

- the soil is strongly calcareous
- in some profiles the texture of the surface horizon is clay loam

Soil Unit K3

Soil Type : Gleyed Rego Black

Parent Material : Lacustrine veneer over moraine

Slope : 1-2%

Drainage Class : Imperfectly

Soil Profile Description

Ah 0-15 cm; black (10YR 2/1); clay loam; amorphous; friable, slightly sticky, plastic, hard; clear, smoth boundary

Cgj 15-60 cm; grayish brown (10YR 5/2); sandy clay loam; common, fine, distinct, reddish brown mottles; amorphous; friable, non-sticky, slightly plastic, hard; gradual, smooth boundary

II Cgj 60-90+cm; grayish brown (2.5Y 5/2); clay loam to clay; common, fine, distinct, reddish brown and gray mottles; amorphous; friable, sticky, plastic, very hard; includes few stones

Comments

- there are inclusions of poorly drained Gleysolic soils in this soil unit

Soil Unit L1

Soil Type : Rego Humic Gleysol - Rego Humic Gleysol, carbonated

Parent Material : Lacustrine

Slope : 0-3%

Drainage Class : Poor

Soil Profile Description

Ah 0-20 cm; black (10YR 2/1); silt loam; weak, fine granular; friable, non-sticky, slightly plastic, slightly hard; clear, smooth boundary

Ckg1 20-50 cm; light brownish gray (2.5Y 6/2); silty clay; many, fine, prominent, reddish brown and gray mottles; amorphous; firm, sticky, plastic, very hard; gradual, smooth boundary

Ckg2 50-70 cm; light yellowish brown (2.5Y 6/4); silty clay loam; many, fine, prominent, reddish brown and gray mottles; amorphous; friable, slightly sticky, plastic, hard; gradual, smooth boundary

Ckg3 70-90 cm; light yellowish brown (2.5Y 6/4); sandy loam; many, fine, distinct, reddish brown mottles; amorphous; friable, non-sticky, non-plastic, slightly hard; gradual, smooth boundary

Ckg4 90-110+cm; light olive brown (2.5Y 5/6) loamy sand/ many, fine, distinct, reddish brown mottles; amorphous; very friable, non-sticky, non-plastic, soft

Comments

- the soil is slightly saline and strongly calcareous
- in some profiles the texture of the subsoil is silty clay throughout

Soil Unit L2

Soil Type : Rego Humic Gleysol

Parent Material : Lacustrine

Slope : 0-1%

Drainage Class : Poor

Soil Profile Description

Ah 0-25 cm; black (10YR 2/1); silt loam; amorphous; friable, non-sticky, non-plastic, soft; clear, smooth boundary

Ckg1 25-65 cm; light olive brown (2.5Y 5/4); silty clay loam; many, fine prominent reddish brown and gray mottles; amorphous; friable, sticky, plastic, hard; clear, smooth boundary

Ckg2 65-90 cm; light yellowish brown (2.5Y 6/4), loamy sand to sandy loam; many fine, distinct reddish brown mottles; amorphous; very friable, non-sticky, non-plastic, soft; clear, smooth boundary

Ckg3 90-120+cm; light olive brown (2.5Y 5/4); silty clay loam; many, medium prominent gray mottles; amorphous; friable, sticky, plastic, hard

Comments

- the soil is moderately saline, moderately sodic and strongly calcareous
- in some profils a sand layer occurs at a depth of 90-100 cm from the surface

Soil Unit L3

Soil Type : Rego Humic Gleysol - Rego Humic Gleysol, carbonated

Parent Material : Lacustrine

Slope : 0-1%

Drainage Class : Poor

Soil Profile Description

Ahk 0-20 cm; black (10YR 2/1); silt loam; weak, medium subangular blocky breaking nto very weak, fine granular; friable, slightly sticky, slightly plastic, soft; clear, smooth boundary

ACkg 20-35 cm; very dark gray (10YR 3/1); silty clay loam; many; fine, faint, reddish brown and gray mottles; amorphous; friable, sticky, plastic, hard; clear, smooth boundary

Ckg 35-100 cm; light olive brown (2.5Y 5/4); silty clay loam; many, fine, prominent, reddish brown and gray mottles; amorphous; friable, sticky, plastic, hard

Comments

- the soil is strongly saline, strongly sodic and strongly calcareous
- in some profiles the textures of the subsoil is silty clay throughout

Soil Unit M1

Soil Type : Rego Humic Gleysol - Rego Humic Gleysol, carbonated

Parent Material : Moraine

Slope : 0-3%

Drainage Class : Poor

Soil Profile Description

Ahk 0-17 cm; black (10YR 2/1); clay loam; weak, very fine granular; friable, slightly sticky, plastic, slightly hard; gradual, smooth boundary

ACkg 17-26 cm; grayish brown (2.5Y 5/2); clay loam to clay; many, fine distinct, reddish brown mottles; amorphous; firm, sticky, plastic, hard; includes few, small stones; clear, smooth boundary

Cgk 26-70+cm; light olive brown (2.5Y 5/4); clay loam to clay; many, fine, prominent, reddish brown and gray mottles; amorphous; firm, sticky, plastic, hard; includes few, small stones

Comments

- the soil is slightly saline and strongly calcareous

Soil Unit M2

Soil Type : Rego Humic Gleysol - Rego Humic Gleysol, carbonated

Parent Material : Moraine

Slope : 0-3%

Drainage Class : Poor

Soil Profile Description

Ahk 0-34 cm; black (10YR 2/1); silt loam; weak, very fine granular; friable, non-sticky, slightly plastic; soft; clear, smooth boundary

Ckg1 34-46 cm; dark gray (10YR 4/1); clay loam; many, fine distinct, reddish brown mottles; amorphous; friable, slightly sticky, plstic, hard; includes few, small stones; gradual, smooth boundary

Ckg2 46-90+ cm; yellowish brown (10YR 5/6); clay; many, medium, prominent reddish brown and gray mottles; amorphous; firm, sticky, plastic, very hard, includes few, small stones

Comments

- the soil is moderately saline, moderately sodic and strongly calcareous

Soil Unit M3

Soil Type : Rego Humic Gleysol - Rego Humic Gleysol, carbonated

Parent Material : Moraine

Slope : 0-2%

Drainage Class : Poor

Soil Profile Description

Ahk 0-25 cm; black (10YR 2/1); clay loam; amorphous; friable, sticky, plastic, hard; clear, smooth boundary

Cgk 25-90+ cm; yellowish brown (10YR 5/4); clay loam to clay; many, fine, prominent reddish brown and gray mottles; firm, sticky, plastic, hard; includes few, small stones

Comments

- the soil is strongly saline, strongly sodic and strongly calcareous

Soil Unit

Soil Type : Orthic Black

Parent Material : Moraine

Slope : 3-5%

Drainage Class : Moderately well

Soil Profile Description

Ah 0-20 cm; black (10YR 2/1); sandy loam; weak, fine granular; frible, non-sticky, slightly plastic, soft; clear, smooth boundary

Bm 20-55 cm; brown to dark brown (10YR 4.5/3); clay loam to clay; weak, fine prismatic; firm, sticky, plastic, hard; includes few, small stones; gradual, smooth boundary

Ck 55-95+ cm; dark yellowish brown (10YR 4/4); clay; amorphous; firm, sticky, plastic, very hard; includes few, small stones

Comments

- the soil is moderately calcareous

APPENDIX 2

SUMMARY OF LABORATORY SOIL ANALYSIS

Site	Depth cm	pH	EC mS/cm	CA meg/l	MG meg/l	NA meg/l	SO4 meg/l	SAR	TGR/T/A @ 15 cm	SAT %
24	30-100	8.3	11.0	42.3	125	169	22.3	32.0	40	
25	0-35	8.3	7.98							54
25	35-100	7.8	12.8							60
26	0-25	7.1	6.08							60
26	25-50	7.6	4.24							48
26	50-90	7.9	4.42							49
27	0-35	7.4	5.31							79
27	50-90	8.1	5.47							52

Soil Reaction - pH		Salt Content (EC)		Sodicity (SAR)	
Neutral	6.6-7.3	Low	2 mS/cm	Low	4
Mildly alkaline	7.4-7.8	Slight	2-4 mS/cm	Slight	4-8
Moderately alkaline	7.9-8.4	Moderate	4-8 mS/cm	Moderate	8-12
Strongly alkaline	8.5	High	8 mS/cm	High	12

pH, Salinity, Soluble Ions, Sodicity, and Saturation Percentage of Selected Soil Samples

Site	Depth cm	pH	EC mS/cm	CA meg/1	MG meg/1	NA meg/1	SO4 meg/1	SAR	TGR/T/A @ 15 cm	SAT %
1	0-20	7.5	4.50							82
1	29-47	8.4	1.21							25
1	47-100	8.3	1.08							34
3	0-17	8.2	2.35							47
3	17-26	8.3	1.44	5.1	3.9	7.8	12.5	3.7		38
3	26-70	8.3	1.34							36
5	0-15	8.0	9.08							60
5	0-34	8.1	7.01							56
5	46-90+	7.9	3.71							37
6	0-25	8.7	32.6	23.7	108	450	400	55.4	414	43
6	25-90	8.6	18.5	25.3	46.6	257	278	42.8	135	36
7	0-25	7.4	7.07							61
7	25-65	8.4	1.78	3.7	2.5	14.7	16.9	8.3	0.4	32
10	0-12	7.9	9.27							54
10	12-65+	8.5	13.7	22.1	24.0	194	200	40.5	77.1	39
12	0-17	8.5	23.0	23.4	135	288	350	32.3	169	53
12	17-35	8.6	14.3	22.6	65.3	164	231	24.7	54.8	42
12	35-100	8.4	10.4	22.2	45.0	115	163	19.9	27.1	43
14	0-15	6.2	3.27							74
14	20-50	8.0	1.57							52
14	50-70	8.1	1.49							49
15	0-26	7.4	6.26							69
15	26-100	8.4	1.94							54
17	0-8	7.2	7.41							74
17	8-90	8.1	4.48							51
18	0-13	7.5	7.70							64
18	13-50	8.1	5.83							47
18	50-110	8.1	5.77							46
20	0-30	7.9	6.08							49
20	30-90	8.1	4.24							42
22	0-20	7.4	10.8	23.2	56.5	105	172	16.7	22.6	69
22	20-60	8.1	7.77							48
22	60-90	8.0	7.73							46
24	0-30	8.3	13.0	21.5	56.7	154	216	24.6	48.2	49

MAPS NOT

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